32. A telephone device according to claim 17, further comprising: a solar cell for an energy supply of the first component and the second component with an assistance of the bus system, said solar cell converting a part of energy situated in the bus system as a result of a transmitted optical signal in to an operating current.

a' cont'd

33. A telephone device according to claim 17, wherein said telephone device is at least one of a telephone set and a telephone receiver and a mobile radio-telephone device.

REMARKS

The foregoing amendments to the specification and claims under Article 41 of the Patent Cooperation Treaty place the application into a form for prosecution before the U.S. Patent and Trademark Office under 35 U.S.C. §371. Accordingly, entry of these amendments before examination on the merits is hereby requested.

Respectfully submitted,

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TELEPHONE SET, TELEPHONE RECEIVER OR MOBILE RADIOTELEPHONE DEVICE

Optical bus systems serve for the communication between opto-electronic assemblies and are traditionally formed of a bundle of light guides or, respectively, optical fibers arranged parallel to one another. The input and/or output of the optical signals to be sent or, respectively, to be received by the assemblies thereby ensues at an interface formed at the start or, respectively, end of the bundle of light guides. In the normal case, a bundle of light guides produces the connection between two assemblies that are respectively arranged at an end thereof. When, however, a plurality of assemblies is to be arranged at an end of the bundle, the bundle must be split into a corresponding plurality of sub-bundles at the end. The splitting of the bundle of light guides into a specific plurality os sub-bundles represents a complicated procedure. Since the inividual [sic] light guides or, respectively, optical fibers are insulated from one another, i.e. a signal transmission does not ensue from one light guide onto another, it is necessary to position the assemblies exactly at the respective ends of the bundle or, respectively, sub-bundle of light guides. Otherwise, a correct transmission of signal between the assemblies is not assured.

EP 0 249 746 merely discloses a single optical fiber for a data bus system that, on the basis of a light-dispersing lead proceeding coaxially in its inside, enables the input or, respectively, output of light through its cladding layer at various locations of its longitudinal extent.

With the mounting arrangement of EP 0 237 237, a single optical conductor at a mounting plate can be brought such into a specific position that it can be coupled to a plurality printed circuit boards attached thereto for different configurations and thereby remains easily accessible for another printed circuit board arrangement, for example by replacement or repositioning. For the respective, given printed circuit board arrangement, the optical conductor is thereby permanently arranged in one and the same position.

EP 0 266 934 merely discloses a manufacturing method for a light waveguide with a specific structure and preparation.

EP 0 366 974 A1 is merely directed to a semiconductor circuit wherein at least two optical connecting layers are optically coupled to at least one light waveguide via an optical printed circuit board. The at least two connecting layers and the light waveguides of the optical printed circuit board are thereby arranged in a permanently given, i.e. fixed spatial allocation and are permanently optically coupled to one another in this one given position.

The invention is based on the object of offering a telephone set, telephone receiver or a mobile radiotelephone device between whose respective assemblies an optimally faultless transmission of optical signals is enabled.

This object is achieved with the assistance of a telephone set, telephone receiver or mobile radiotelephone device, particularly cell phone, conforming to the features of claim 1.

In that the optical bodies of the bus system are arranged above one another or layered on top of one another such that they are movable relative to one another and thereby simultaneously remain in optical contact with one another, a largely faultless transmission of optical signals is always assured between the two components of the telephone set, telephone receiver or mobile radiotelephone device, particularly both in the off and standby condition as well as in the on condition. Since the two components are coupled to the optically conductive bodies of the bus system that are movable relative to one another, it is not necessary to electrically connect them to one another, for example with a flexible printed circuit board. Due to the superimposed arrangement or, respectively, superimposed layering of the optical bodies, these can relative to one another practically arbitrarily often. Wear problems that could occur, for example, given an electrical connection of the two components with a flexible printed circuit board are thus largely avoided. In this way, thus, the risk of degradations or even interruptions of the signal transmission between the two components can be largely avoided. In a simple way, thus, a faultless transmission of optical signals, particularly of data and/or energy, between the components of, for example, a mobile radiotelephone device can be largely permanently achieved.

Further, in particular, a bus system is offered for the transmission of optical signals that comprises at least one optical conductive body. Optical signals of

electrical assemblies are supplied to or, respectively, taken from the body via predetermined interfaces that occur multiply. The structure of the optically conductive body is of such a nature that an optical signal input at an interface can be coupled out at any other interface regardless of its position. The delivery of the optical signals by the electrical assemblies can thereby ensue, for example, via light-emitting diodes, laser diodes, etc., whereas the taking thereof can ensue, for example, with photodiodes, solar cells and phototransistors or other opto-electronic components.

The bus system can, in particular, be fashioned as a plastic body when the optically conductive body is manufactured of a shapable material. As a result thereof, a plurality of interfaces for the input and/or output of optical signals in the inside of the optically conductive body can also be formed after fabrication of the optically conductive body by merely pressing corresponding components into the optical conductive body. When, in comparison thereto, the optically conductive body is formed of a non-shapable material, then a bus system having a fixed shape is created that advantageously has adequate resistance to mechanical stressing.

Further, transmission losses within the bus system can be minimized in that the respective optically conductive body is expediently formed of a material that conducts light in directed fashion.

Advantageously, even low-energy signals can thus be transmitted. When, according to another development, in contrast, the optically conductive body is manufactured of a material that conducts light in undirected fashion, then the interfaces via which optical signals are supplied to or, respectively, taken from the bus system can be arbitrarily selected.

The optically conductive body can, further, be preferably formed of a material that particularly conducts light in the infrared range, in the visible range or in the ultraviolet range. Suitable materials are, in particular, plastics such as plexiglass, PVC, acrylic, as well as glass and light-transmissive liquids.

Interfaces for the input and/or output of optical signals can, for example, be particularly formed in a simple way in that the photoelements of the respective assemblies are either arranged in the inside of the optically conductive body and

surrounded by it or the exterior surface of the optically conductive body to which the photoelements are attached is suitably prepared for and admission or output of light, for example by forming a surface structure that allows a partial input and/or output of light.

The optical contact between two optically conductive bodies can, in particular, be produced in a simple way in that the bodies are layered on one another or, respectively, arranged on top of one another such that surface regions of the bodies overlap. The surface regions -- which are in turn suitably prepared for an entry or exit of light -- can thereby either touch one another or reside opposite one another at a distance to be defined. Since there is no fixed connection between the bodies, they can be shifted or, respectively, turned relative to one another.

When, according to another development, the two components are respectively arranged within an optically conductive body, a compact electrical device is created whose contour can be arbitrarily designed.

The inventive bus system can be advantageously employed in an electrical apparatus wherein the first component comprises a signal input device and the second component comprises a signal output device. For example, a telephone set, particularly a cell phone, or a telephone receiver can be formed, whereby the first component contains a keyboard and a microphone and is arranged in the first optically conductive body, and the second component contains a display and an earphone and is arranged in the second optically conductive body.

Further, an arbitrary plurality of further conductive bodies can be coupled to the inventive bus system, whereby each of the optically conductive bodies can comprise one or more light-emitting and/or light-receiving elements. And arbitrarily large or, respectively, high-performance bus system can thus be produced.

The inventive bus system is described below on the basis of a specific embodiment.

According to the embodiment, the bus system is shown in conjunction with a mobile wireless communication system, for example a mobile radiotelephone device according to the GSM standard.

The bus system is thereby formed by, for example, two bodies having a cuboid shape that are cast from an optically conductive material such as acrylic and form the lower shell and upper shell, i.e. the housing, of the mobile radiotelephone device. In particular, a material is selected that is selectively transparent for infrared light and that conducts light in undirected fashion.

A first component is cast into the upper shell, said first component comprising, among other things, a first energy store to be supplied via the bus, a keyboard, a microphone, a first control circuit and -- as opto-electronic components (coupling elements) -- a light-emitting diode as well as a photodiode. Compared thereto, a second component is cast into the lower shell and comprises, among other things, an energy store to be supplied from the outside, a liquid crystal display, an earphone, a second control circuit and -- again as opto-electronic components -- a light-emitting diode as well as a photodiode. The components of the first and second component are electrically connected to one another in a suitable way, whereas the opto-electronic components are respectively in optical contact with the upper shell or, respectively, lower shell. The respective components can be arbitrarily arranged within the upper shell and lower shell.

The upper and lower shell of the mobile radiotelephone device are directly layered on one another, whereby the sides lying opposite one another are matched to one another and are merely connected to one another by a guide device that allows a relative displacement of the lower shell with respect to the upper shell. In the off condition as well as in the standby condition of the mobile radiotelephone device, the sides of the upper and lower shell lying directly opposite one another overlap completely, whereas they partially overlap in the on condition. In both the off condition and in the standby condition as well as in the on condition, the upper shell and lower shell are in optical contact with one another. So that the optical contact is also maintained in the on condition, wherein the sides of the upper and lower shell lying directly opposite one another only partially overlap, the overlapping regions are

fashioned such by formation of a suitable surface structure, for example by polishing, that light from the upper shell can proceed merely unimpeded into the lower shell and vice versa.

The transmission of signals between the respective components via the bus system ensues in that the first component converts electrical signals into optical signals with an opto-electronic component, said optical signals being supplied via an interface to a first optical conductive body of the bus system. The first optically conductive system transmits the optical signals onto a second optically conductive body that is in optical contact with the first body. A second component takes or, respectively, receives the optical signals via an interface of the second optically conductive body with another opto-electronic component that converts the optical signals into electrical signals. A bidirectional transmission of signals is enabled in that the respective components [sic] is equipped both with an opto-electronic component that is suitable for the conversion of electrical signals into optical signals, such as a light-emitting diode, as well as with an opto-electronic component that is suitable for converting optical signals into electrical signals, such as a photodiode. Since the upper shell and lower shell are not electrically connected to one another, for example by a flexible printed circuit board, they can be moved arbitrarily often relative to one another without there being any risk of damaging the electrical connection.

The type of relative movement of the upper shell and lower shell relative to one another, i.e. a displacement, turning or hinging of the upper and lower shell relative to one another is thereby defined by the design of the guide device.

The optical signals transmitted by the bus system can, on the one hand, represent data, i.e. information, but, on the other hand, can also represent energy that is needed by the respective component for offering an operating current or, respectively, an operating voltage that is not supplied from the outside via an electrical conductor.

For components having very low power consumption, the energy supply via the bus system can, for example, ensue via a solar cell that converts a part of the energy situated in the bus system due to the transmitted optical signals into an

operating current. In particular, the energy supply of an LCD can ensue in this way, the power requirements thereof only amounting to a few micro-amperes.

Specific circuit measures are required given components with a higher power consumption. Given, for example, a packet-oriented transmission of data, an energy store such as a capacitor, a coil, etc., can be charged with energy via the bus system. The effective data transmission rate is then defined, among other things, by the amount of energy available for the transmission of the individual data packets. The operation of a keyboard can ensue in this way.

The energy supply of acoustic components such as a microphone or an earphone requires a relatively high power consumption that is offered by a high-capacity energy store such as, for example, an accumulator or a high-capacity capacitor, for example a “gold cap”.

In this embodiment, the energy supply of the mobile radiotelephone device overall and of the second component located in the lower shell ensues with the second energy store, which is fashioned as accumulator and is supplied or, respectively, charged from the outside via a supply line. The energy supply of the first component situated in the upper shell, which comprises a microphone and thus has a relatively high power consumption, ensues with the first energy store, which is likewise fashioned as accumulator or a high-capacity capacitor, for example a “gold cap”, but is supplied or, respectively, charged via the bus system. Alternatively, the energy supply of the first component can ensue via an electrical line that is connected to the externally supplied energy store of the second component.

For protection against mechanical damage and for shielding external noise influences, the outsides of the upper shell and lower shell of the mobile radiotelephone device are provided with a light-impermeable coating.